The CHEMIST

MAY and SUMMER, 1942 VOL. XIX, No. 5

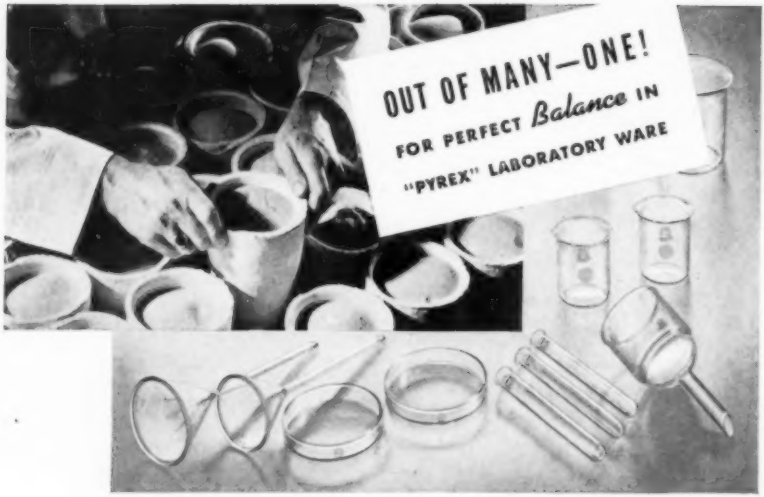
WILLIAM LLOYD EVANS

• • •

SOME OF THE CHEMICAL REACTIONS OF THE REDUCING SUGARS IN ALKALINE SOLUTIONS

• • •

SYMPOSIUM—THE CHEMICAL INDUSTRY AT WAR



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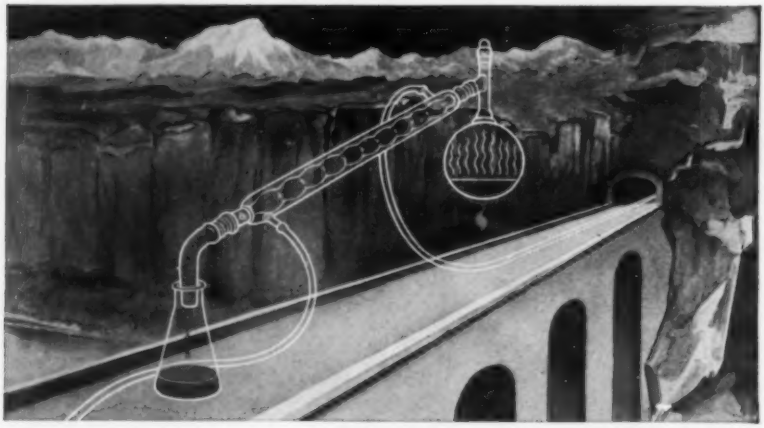

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Twentieth Annual Meeting of the American Institute of Chemists, Inc.

Dr. William L. Evans, Dr. Harry L. Fisher,
Dr. H. B. Hass, and Dr. Robert J. Moore

The twentieth annual meeting of THE AMERICAN INSTITUTE OF CHEMISTS was held at The Claridge Hotel, Atlantic City, New Jersey, on Saturday, May 16, 1942. Despite the war demands on the time of many of our chemists, the attendance was excellent, and the interest shown in the professional status of chemists exceedingly encouraging.

A luncheon meeting of the National Council was held at noon, followed by a meeting of the Board of Directors. A luncheon arranged for the ladies was presided over by Mrs. Robert J. Moore.

The symposium in the afternoon, entitled, "The Chemical Industry at War" aroused much interest and discussion, and emphasized the important role of chemists in this Wartime emergency. Dr. Gustav Egloff, newly elected president, spoke on "The Petroleum Chemist at War"; Dr. Donald Price, newly elected vice-president, on "The Chemist in Today's Industry"; and Dr. A. B. Ray on "The Technical Point of View". Dr. Egloff's article will be featured in the September issue of THE CHEMIST. The other addresses are printed in this issue. Colonel O. C. Wyman was scheduled to speak on "The Chemical

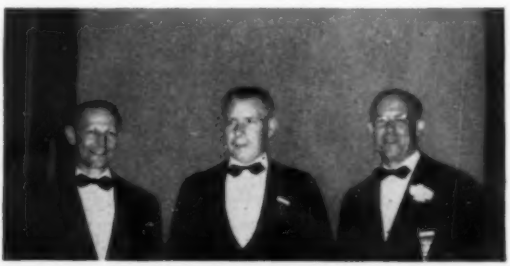
Industry, Selective Service and the War Effort". A throat affliction made it impossible for him to speak, and after he was introduced, Captain George E. Pierson, Jr., spoke in his place. Army regulations do not permit us to publish his talk, even though the information given has already appeared in print in various places. It was explained that material quoted by the Army would naturally be correct, and selected from the great mass of comment appearing in magazines and newspapers on various subjects, and that this approved selection of correct material might be of aid to the enemy.

During the business meeting following the talks, the reports of the various committees and chapters of the INSTITUTE were presented. These reports were printed in the preceding issue of THE CHEMIST.

The election of the following new officers and councilors was announced: President, Dr. Gustav Egloff; Vice-president, Dr. Donald Price; reëlected Treasurer, Mr. Walter J. Murphy; reëlected Secretary, Mr. Howard S. Neiman. Reëlected Councilors, Dr. Donald H. Andrews, the late Dr. Henry G. Knight, and Dr. Foster D. Snell.

Through the courtesy of President Fisher, a reception preceding the banquet was given for Dr. William Lloyd Evans, medalist.

The medal of THE AMERICAN INSTITUTE OF CHEMISTS for 1942 was presented to Dr. Evans at the banquet held in the evening, at which Dr. H. B. Hass, chairman of the Department of Chemistry of Purdue University spoke on "The Career of the Medalist", and Dr. Evans gave an illustrated lecture on "Some Chemical Reactions of the Reducing Sugars in Alkaline Solutions". Both of these papers appear in this issue of THE CHEMIST.



Dr. W. D. Turner, Dr. Frank O. Lundstrom, and Dr. Harry L. Fisher

Underwood and Underwood

NEW OFFICERS — 1942-1944

Above: Gustav Egloff, President
Lower Left: Howard S. Neiman, Secretary
Lower Right: Donald Price, Vice-president

WALTER J. MURPHY, *Treasurer*

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DONALD H. ANDREWS

William Lloyd Evans

***By* Dr. H. B. Hass**

Head, Department of Chemistry, Purdue University

WE HAVE met this evening to honor a great man. William Lloyd Evans has been chairman of one of the greatest departments of chemistry in the United States, has received the Nichols medal, and is a past-president of the American Chemical Society, but only those who have been intimately associated with him can appreciate his stature as a man and as a chemist.

The story of his life is as American as a fourth of July celebration. Born the son of Welsh immigrants in Columbus in what has been called "the most typical of all the United States", Evans graduated at the age of twenty-two from the Ohio State University. He then became chemist for the American Encaustic Tile Company at Zanesville, but returned for his M.S. degree, which he obtained in 1896 as University Fellow.

It is difficult for those of our generation to realize that Ohio State was at that time a small school with a Department of Chemistry consisting of only four members, all well known to most of us. These were Wm. McPherson, chairman, who was president of the American Chemical Society in 1930; W. E. Henderson, whose name became associated with that of McPherson in a justly famous series of textbooks; C. W. Foulk, who became well-known for his texts on quantitative analysis and work on boiler foaming, and James Withrow, who was to become head of the Department of Chemical Engineering at Ohio State.

The University of Chicago was the Mecca of graduate activity in the middle west and on its faculty was a brilliant young Swiss chemist, student of von Baeyer, by the name of J. U. Nef, whose radical theories of bivalent carbon atoms were exciting organic chemists the world over. Here Evans went for his doctorate work after having obtained experience as assistant in the Department of Ceramics at Ohio State and as high school chemistry instructor at Colorado Springs, Colorado.

Evans returned from the University of Chicago in 1905 with his Ph.D. degree and a burning determination to carry on research despite any obstacles. He once said to me, "Henry, I vowed that if I couldn't

get anything but a flask, a Bunsen burner and a reflex condenser, I would keep water boiling in it. I might learn something just by watching it". Fortunately, his aspiration for scientific achievement was viewed sympathetically by the university administration. The school was growing with tremendous rapidity; in less than two decades it expanded to one of the largest universities in America because of a combination of circumstances which included such diverse factors as a shifty-hipped, All-American half-back named Chick Harley and a presidential genius, William Oxley Thompson, who for a quarter of a century succeeded in making a friend of Ohio State University out of almost every member of the State Legislature.

Evans' teaching duties at Ohio State were principally in general chemistry. During his career he lectured to more than forty-five thousand students. The successful administration of a group of thirty or more graduate assistants teaching two thousand freshmen is no easy problem and there was no doubt in the minds of either students or assistants that Evans knew how it should be done. The weekly staff meeting served as a sieve for ideas contributed by assistants from almost everywhere in the country. No one was ever squelched for presenting a novel approach or a different way of teaching a fact or principle. Partly by selecting the best contributions of the staff over a long period of years, Evans built up a very superior course and at the same time made us young men feel that we were all partners in a common effort. He was always most generous in awarding praise and credit for originality. For example, a spur-of-the-moment suggestion of a first-year assistant, as to how carbon dioxide could be absorbed and measured quantitatively in apparatus already present in the freshman lockers, resulted in his name being added to a paper in the *Journal of Chemical Education*, where by any ordinary standards it did not belong.

We knew that when we came to staff meeting we were supposed to know the subject matter of next week's assignment; when we left we felt that we knew how to teach it. We undoubtedly made our individual blunders but we all gave the student the same picture of the salient points.

All of the junior staff attended Evans' lectures—not merely the first year but every year. Recently Dr. G. P. Hoff, of du Pont Rayon, told me, "There is nothing I would rather do right now than hear Billy Evans lecture for an hour on freshman chemistry". There is the same kind of

esthetic enjoyment in listening to an Evans' lecture as in watching a Tilden tennis match; you witness a master performance. Evans' voice, cultivated by a lifetime of singing and musical interest, was as resonant as a bull-fiddle. No one strained to hear; you could understand every word from a position out in the hall where tardy students were sometimes forced to remain. He could, by exercise of the imagination, put himself in the position of the humblest student whose mind, terrified by the formidable-sounding nomenclature of chemistry, was trying, in an ameba-like way, to flow around and assimilate a new idea. Evans believed in lectures plentifully besprinkled with demonstrations. None of us will ever forget the first lecture in qualitative analysis for the metals in which the twenty-three cations with which we dealt were in solution in as many foot-beakers. Hydrochloric acid was added to each and only three precipitated. Then hydrogen sulfide was bubbled into each one and Group II came down. At the end of that lecture even the stupidest student had a crystal-clear concept of the fundamental principles of qualitative analysis.

And there were stupid students at Ohio State. I'll never forget Lee Roy Jones, who once in my class spelled his name "Jons". I asked him if I had it wrong in the roll book whereupon, with a sheepish grin, he replied, "No, Sir. I got it wrong 'at time".

Evans had a warm sympathy with a struggling student but he never compromised with those who desired low scholastic standards. He studied general chemistry as hard as any of his freshmen, not just once but every year. He had a passion for accuracy and up-to-the-minute information; although his scholarship was so thorough that he could quote from discoveries of the Chinese alchemists, the course was as fresh as today's newspaper.

The life of W. L. Evans must be a source of infinite perplexity both to the researcher who believes that a man cannot do good creative work and teach freshmen and the obsolescent, but still extant, type of pedagog who says that research men can't teach. The psychologists tell us that there is a positive correlation between all human excellencies, but so few men can teach as well as Evans and so few have directed so much fundamental research, that the statistical probability of one man excelling to such an extent in both fields is indeed small.

One of the great causes of Evans' success was his enthusiasm. Nearly every one of his former students has urged me to refer to this

attribute in this evening's address. The Greek roots of the word are suggestive; "enthusiasm" means "inspired by a god" and in Evans' case the source of inspiration was, I think, a profound belief that discoveries in pure chemistry, additions to the sum-total of human knowledge, would ultimately result in the advancement of civilization.

When I hear scientists referred to as cold, calculating, sub-human beings, devoid of all mental processes except the exercise of the power of reason, I strongly suspect that the speaker never knew a scientist of the caliber of Evans. We all took our personal problems to him and received sound, fatherly advice. Once when I was working in the room which functioned as Evans' office and also as a small research laboratory, an undergraduate by the name of R. H. K. Foster came in and asked him to help him decide whether he should make music or chemical engineering his life profession. Evans had faced the same decision as a youth. Like many Welshmen, Evans is highly musical. He had played the violin as the youngest member of the Columbus symphony orchestra, sung in the Ohio State Glee Club and directed it for two years while Mrs. Evans—who as an undergraduate had been the leading lady in campus dramatics—directed the Women's Glee Club. He organized choruses of men and women at Colorado Springs and edited the *Ohio State University Song Book*. He advised Foster to retain music as an avocation but to make chemical engineering his life work. Evans continually urged the cultural value of music upon his students. The following excerpt from one of his lectures is typical:

"How many of you heard the symphony concert last night? Hands up—Good. But there ought to be more. Young people, learn to know the great art of music, it will add *ten years* to your life".

Evans' scientific work should serve as an inspiration for professors who must carry a heavy teaching load and who also have the responsibility of directing the researches of large numbers of graduate students. With but few exceptions, all of Evans' graduate research has been directed toward the goal of reaching a closer understanding of the mechanism of carbohydrate oxidation. The untimely death of J. U. Nef in 1915 resulted in a number of his former students, such as Evans, Spoehr, Upson and W. L. Lewis, taking up various phases of these unfinished problems according to their interests, abilities, and opportunities.

Evans began with such simple compounds as ethanol, acetaldehyde, 2-propanol and acetone and subjected them to the action of neutral and

alkaline potassium permanganate. Conditions of temperature and concentrations of reagents were accurately controlled and systematically varied. The products, usually acetic acid, oxalic acid and carbon dioxide, were measured quantitatively and, at a time when it was frequently the practice among organic chemists to pay little attention to by-products, Evans and his students were accounting for 100 per cent ± 0.3 per cent of the carbon atoms present in the reactants.

When the behavior of the simpler compounds under these conditions had been rigorously proved and plausible reaction mechanisms proposed, the more difficult and complicated carbohydrates were studied. It became necessary to examine the oxidation of the less readily available trioses and pentoses and to discover what effect the potassium hydroxide would exert in the absence of permanganate ion. Afterward the oligosaccharides were similarly investigated and as the work developed it became desirable to synthesize new sugars as well as compounds not previously known, which were capable of functioning as intermediates in the oxidation processes.

So far as I am aware, this experimental work, performed by more than fifty different graduate students, has never been challenged in any particular. Anyone familiar with the variations in the experimental ability of different students and the almost complete absence of technique courses in the Ohio State graduate curriculum over this period of time must stand in awe at such an achievement. It was accomplished by daily research conferences in which Evans came to the laboratory and discussed individually with his men the results of that day's research. Suggestions flowed freely. Many of us remember how often a contribution was prefaced by: "When I was shaving this morning I had an idea . . . "

On the other hand, Evans always gave sympathetic attention to suggestions from his men. He was the personification of democracy at its best.

It is my personal belief that some of the reaction mechanisms proposed by Evans and his students will be modified in time. The Nef theory has been outmoded by the discovery that the internuclear distances between carbon and oxygen in carbon monoxide correspond to a triple bond rather than a double bond and the same sort of thing is true of the carbon-nitrogen distance in the fulminates and isonitriles. The physical chemists have convinced all of us that a double bond is

really about twice as strong as a single bond so that fission occurs not at a double bond but between the carbon alpha to the double bond and its neighbor in the beta position. Thus, methylglyoxal and lactic acid are derived not from the 3,4-enediol, as we assumed, but from the 1,2-enediol. Neither Nef nor Evans can be blamed, however, for not being able to anticipate all of the results which the newer techniques of electron diffraction and spectrum analysis have made available.

I have tried to appraise Evans as a man, a teacher, and a researcher. There remains a fourth aspect of his personality, his career as chairman of the Department of Chemistry at a great university. When Evans assumed this position in 1928 the record of chemistry at Ohio State was honorable and the future looked bright. The Legislature was inclined to be generous and many of the best graduate students and young doctoral men in the country were attracted to positions there. It may be difficult for many residents of this part of the country to believe it, but a young man about to graduate from one of the small colleges in Ohio was once asked by the head of his department of chemistry whether he wanted to go to Ohio State for graduate work or to one of the "Big Three" and he stared back in amazement that anyone should consider any other university to be in a class with the school where Evans was. I know, because I was the young man.

You all know how quickly and thoroughly plans were shattered shortly after 1928. Incomes were curtailed while teaching loads were increased by a flood of high school and college graduates who were unable to find industrial positions. Research budgets suffered inevitably. Even doctoral men were often unable to find positions in many cases. Evans was forced to make a hard decision between two alternatives, whether to allow graduate assistants to remain past their normal period of employment when they were unable to find jobs or to force them out to make room for new men wanting doctoral training. The long-term wisdom of the latter policy is evident now that the normal shortage of well trained chemists in the United States is again felt but it required courage to adopt it in the thirties. New staff members were selected by Evans with the most elaborate care. The younger group at Ohio State includes men such as Brode, Fernelius, Garrett, Harris, Henne, Johnson, Lassattre, Moyer, Newman, Quill, and Wolfrom, each outstanding in his field and each bearing testimony to Evans' ability to select capable men.

When the World War of 1917-18 challenged the United States to

meet the threat of chemical warfare, Evans was prompt to do his part. He was head of the Laboratory and Inspection Division at Edgewood Arsenal with the rank of major.

The American Chemical Society recognized the many-faceted personality and scientific achievements of Evans by electing him president for 1941. The growth of the Society during that year, the constructive accomplishments, and the energy which Evans gave to his new duties are well-known. Although past the three score years and ten, Evans met the long, exhausting, speaking tours with a success to be envied by many younger men.

There is one incident, however, which to me best typifies the qualities which cause us to love and admire Dr. Evans. Up in northern Indiana one of Evans' former students, Dr. Carl Holl, is dean of Manchester College. Manchester has too small a Department of Chemistry to be approved by the American Chemical Society but Dr. Holl has sent so many superior graduate students to Purdue that it is perfectly evident to us that he is able to inspire his students to great achievement. At Dean Holl's request, Dr. and Mrs. Evans spent a day on the Manchester campus, one that will be long-remembered there, a day taken out of a busy life crowded with duties and responsibilities and devoted to the priceless art of making and keeping strong friendships.

Today Dr. Evans is retired from active service to Ohio State by virtue of having passed his seventieth year. His consulting work continues and he is once more trying to help our country to win a war. May his example serve to inspire us all to greater efforts in the grim and noble task which has been forced upon the United States of America!

Dr. H. B. Hass, Dr. Robert J. Moore, and Mr. H. S. Neiman

Some of the Chemical Reactions of the Reducing Sugars in Alkaline Solutions*

By William Lloyd Evans

Department of Chemistry, The Ohio State University, Columbus, Ohio

AN EXAMINATION of the literature of chemistry prior to the turn of the century reveals many interesting facts concerning the behavior of the reducing sugars in alkaline solutions. Much of the data of that period appears in no wise to have a common relationship. Consequently, this body of important material seemed destined to remain in the annals of our science as a group of non-related facts.

This state of affairs should occasion no surprise, because it was in 1869 that Fittig[15] made the first suggestion with reference to structure of the glucose molecule. In the following year, 1870, Adolph von Baeyer[1] published his classical paper in which he set forth his views concerning the formation in Nature of this most important of all sugars, from carbon dioxide and water. Other suggestions with reference to the molecular structure of glucose soon followed, notable among which were the epoch making ring formulas of Tollens[30] in 1883. One of these, the furanoid formula, was destined to play an important rôle in the solution of this difficult question.

At this point, it should be recalled that Emil Fischer[13] published two remarkable papers in 1891—fifty-one years ago. By the use of the van't Hoff concept of the asymmetric carbon atom, he added to the field of stereochemistry one of its most brilliant chapters.

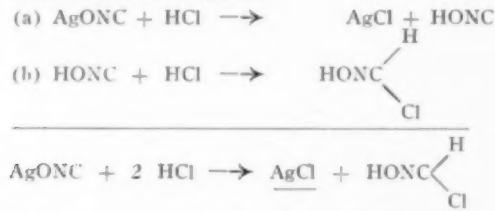
Since the suggestions of Fittig[15] in 1869 and Baeyer[1] in 1870, a half century or more was yet to pass before the chemist felt certain that he was standing on sure ground with reference to the structure of the glucose molecule. It was in 1926, that Haworth[8] and his school established by the methylation reaction that glucose, (dextrose, or grape sugar) was not a furanoid structure but rather a pyranoid compound. He named this group of sugars the pyranoses. From the foregoing, it is evident that the theoretical aspects of carbohydrate chemistry were developing slowly, but yet very surely. It was not until 1926 that the first derivative of glucose containing the free aldehyde group was

*The American Institute of Chemist's Medal Address for 1942 delivered at the Twentieth Annual Meeting, Atlantic City, New Jersey, May 16th.

isolated. In that year, Levene and Meyer[19] synthesized aldehydo pentamethyl D-glucose, a liquid. In 1929, Wolfrom[34] succeeded in preparing crystalline aldehydo-D-glucose pentaacetate, a second derivative of glucose containing the free aldehyde group.

In the 1890's and the first fifteen years of this century, John Ulric Nef[25], of the University of Chicago, was concentrating all his research efforts towards the development of a general theory of organic chemical behavior. The central postulate of his ideas was the assumption that in all organic chemical reactions an intermediate compound of fugitive existence was always formed through a process of dissociation (non-electrolytic) of one of the reacting substances.[32] This fleeting compound possessed a bivalent carbon atom to which Nef ascribed the property of high reactivity. It was furthermore assumed that this active molecular fragment could add reagents, undergo rearrangement, or polymerize.

Nef[22] came upon these ideas concerning the formation of an intermediate compound containing a bivalent carbon atom by reason of his masterly work on the molecular structure of the isocyanides and fulminic acid. In his studies on the fulminates, he found that one mole equivalent of hydrochloric acid would precipitate only one-half the silver in one mole equivalent of silver fulminate. He found that the following reactions had taken place:



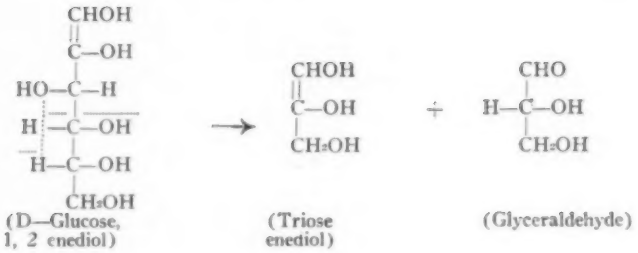
In his studies on the dissociation phenomena in the sugar series, Nef[22] applied his ideas concerning the mechanism of organic chemical behavior with much success in his most difficult research work in the sugar series. Since his theory of organic chemical reactions postulated the formation of a bivalent carbon atom intermediate, it was not surprising that he adopted the views of Hlasiwetz and Habermann[18], Emil Fischer[14], and Wohl and Neuberg[33] concerning the enediolic structure of the reducing sugars in alkaline solution. It will be clear from the following reactions that a fragmentation of the enediolic form at the double bond would yield the intermediate needed by Nef[22].

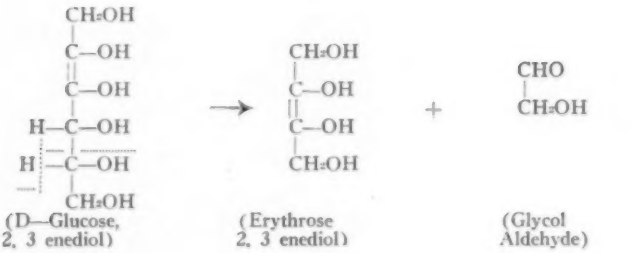
(α, β, D-Glucose)
(Aldo-D-Glucose)
(D-Glucose 1,2 enediol)
(D-Arabinose (active form))
(Formaldehyde (active form)) +
(Glycol Aldehyde (active form)) +
(D-Glucose 2,3 enediol)
(D-Erythrose (active form))
2
(Glyceric Aldehyde (active form))
(D-Glucose 3,4 enediol)

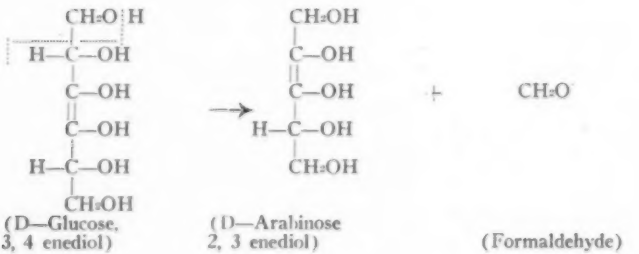
In accordance with Nef's[29] views, it became very evident how easily alkaline oxidizing media, such as a suspension of copper hydroxide in a solution of sodium hydroxide, would rapidly give the acids corresponding to the active fragments formed in each case either as an intermediate compound or as a final product. These acids should be arabonic, erythronic, glyceric, glycolic and formic acids. Should erythrose and arabinose undergo epimerization to threose and ribose respectively in such a system, then in addition to the above reaction products, threonic and ribonic acids should also be present. It should also be noted that the individual aldoses formed in the fragmentation process may undergo a further degradation before oxidation takes place. These theoretical reaction products to which Nef's views point were obtained by him experimentally.

It is evident that before we can know the chemical changes that take place in the absence of oxidizing agents, it is necessary to know the behavior of the alkali on each individual fragment obtained in the degradation of the glucose molecule as indicated in the above reactions.

In the light of present day knowledge with reference to the strength of the double bond of carbon bound to carbon and that the single bond of carbon to carbon, modern physical chemistry has shown that the double bond is the stronger of the two, and hence the fragmentation of the hypothetical enediols cannot occur at the double bond as Nef had assumed. This is in harmony with the views of Schmidt[28] who has pointed out that the fragmentation of an organic molecule containing a double bond takes place at the carbon to carbon single bond second removed from the ethylene bond. This would mean that the fragmentation process suggested by Nef would yield the same products as that proposed by Schmidt. The only point of difference lies in the point of fission of the enediolic form of the reducing sugar. Accordingly, the fragmentation of the enediolic forms of the reducing sugars in alkaline solution should be represented as follows:


(D—Glucose, 1, 2 enediol)
(Triose enediol)
(Glyceraldehyde)


(D—Glucose, 2, 3 enediol)
(Erythrose 2, 3 enediol)
(Glycol Aldehyde)


(D—Glucose, 3, 4 enediol)
(D—Arabinose 2, 3 enediol)
(Formaldehyde)

Nef's[24] experimental studies of the behavior of D-glucose in alkaline solutions reveal the presence of three pairs of epimeric lactones of the saccharinic acids formed through the rearrangement of the reducing sugar molecule. In addition he obtained a number of compounds which contained fewer carbon atoms than the original sugar. Among these were lactic acid and butyro-lactone. The presence of these latter compounds as reaction products clearly shows that fragmentation of the sugar molecule had occurred in the alkaline solution. Hence, it is evident that the reactions of the reducing sugars in alkaline solutions may be classified into two groups. In one are found the products of reaction which arise from a *rearrangement of the sugar molecule*, while in the second class are found the products arising from the *fragmentation of the sugar molecule* and the subsequent reaction of the fragments with the alkali present.

The part played by certain physical chemical factors, such as temperature and concentration of the reactants in determining the character and yields of the several reaction products when reducing sugars are acted upon by alkaline solutions, has not received as much study as its importance would warrant. This is equally true concerning the oxidation of the carbohydrates in alkaline solution. A study of the influence of these factors has shed much light on the molecular life history of the reducing sugars in alkaline solutions both in the presence and absence of oxidizing agents.

The following are two simple cases of the behavior of reducing sugars in alkaline oxidizing media:[2] (a) When D-mannose (0.025 M) and L-arabinose (0.025 M) were oxidized with silver oxide in 1.0 N potassium hydroxide at 50°C, carbon dioxide and oxalic, glycolic and formic acids were formed as reaction products. The experimental results obtained after the reaction had reached completion are given in the following table as moles of reaction products per mole of sugar used.

Oxidation Products	Mannose	Arabinose	Differences
Oxalic Acid	0.98	0.89	0.09
Formic Acid	2.69	1.64	1.05
Glycolic Acid	0.56	0.71	-0.15
Carbon Dioxide	0.19	0.13	0.06
Atoms Oxygen Consumed	6.69	5.46	1.20

The above results would seem to show that the D-mannose molecule is oxidized in such a manner as to yield one molecule more of formic acid than D-arabinose will give under the same experimental conditions. On theoretical grounds this indicates that the D-mannose 1,2 enediol was oxidized at the double bond, a point of view in harmony with that of the generally accepted oxidation mechanism at the carbon to carbon double bond. It has been shown by Conaway[6] that in the absence of an oxidizing agent that L-arabinose will yield lactic acid, and O'Donnell[12] has shown that this is true for D-mannose also, i.e., the sugar molecule in each case was fragmented with the production of glyceraldehyde, a precursor of lactic acid formation. These statements mean that in alkaline solution, and in the absence of an oxidizing agent, the D-mannose 1,2 enediol and the L-arabinose 1,2 enediol, there was a fragmentation of these molecules at the single bond twice removed from the double bond, while in the presence of an oxidizing agent the double bond was the point of attack.

This type of oxidation study is well shown in reaction of D-fructose towards silver oxide in alkaline solutions. Some of the theoretically possible fragmentation products of D-fructose (0.075 M) were oxidized at 50° C in an alkaline solution (1.00 N KOH) in the presence of silver oxide. The quantitative data obtained by Busch, Clark, Genung and Schroeder[2] under such conditions are shown in the following tables:

Oxidation Products in Moles Per Mole of Substance Oxidized

Oxidation Products	Erythritol	Glycol-Aldehyde	Sum	Fructose	Difference
Carbon Dioxide	0.124	0.046	0.170	0.18	-0.010
Oxalic Acid	0.594	0.324	0.918	0.85	0.068
Formic Acid	1.045	0.590	1.635	1.77	0.135
Glycolic Acid	0.803	0.36	1.163	1.17	0.007

Oxygen Consumption — Moles Per Mole of Substance Oxidized

	Erythritol	Glycol-Aldehyde	Sum	Corrected for Erythrose	Fructose
Oxygen, Used	5.07	2.05	7.12	6.12	6.10
Oxygen, Calc'd	4.88	2.01	6.89	5.89	5.86

Comparison of Oxidation Data for Fructose (One Mole) and Glycolaldehyde (Three Moles)

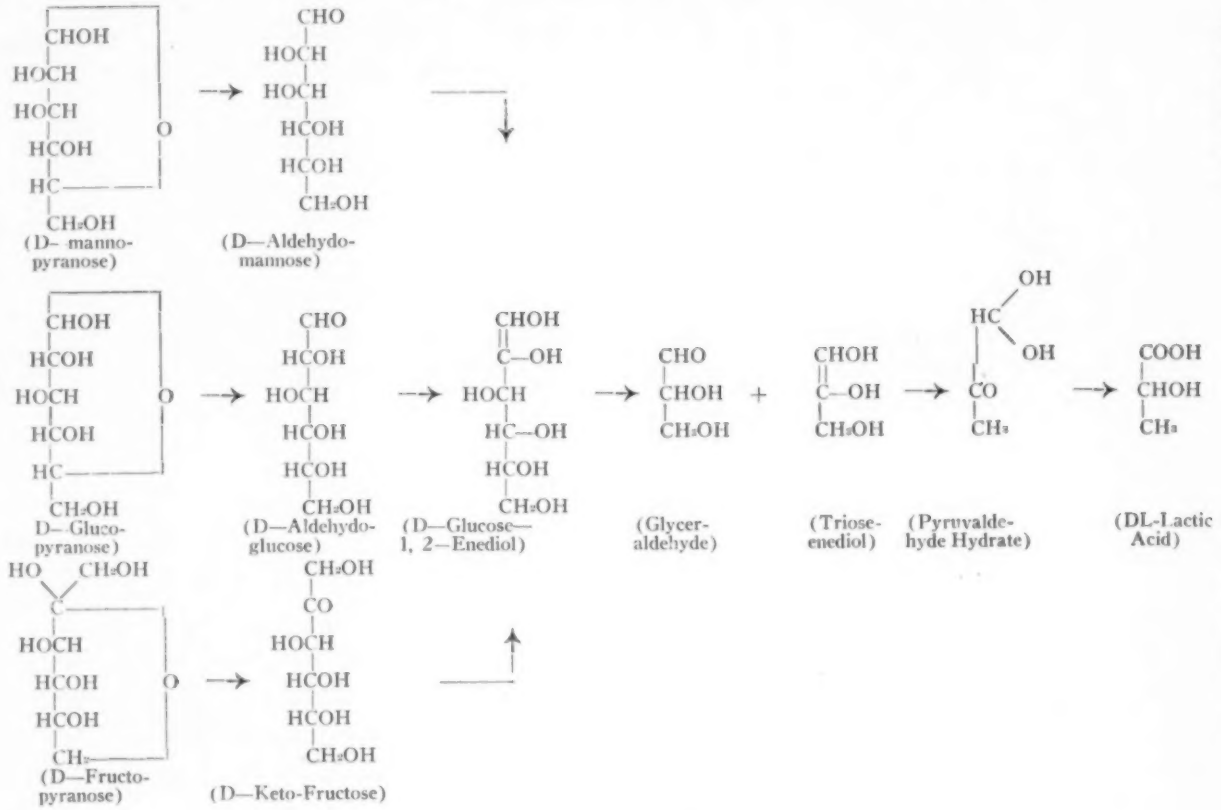
Oxidation Products	Glycolaldehyde (Three Moles)	Fructose (One Mole)	Difference
Carbon Dioxide	0.14	0.18	-0.04
Oxalic Acid	0.97	0.85	0.12
Formic Acid	1.77	1.77	0.00
Glycolic Acid	1.08	1.17	-0.09
Oxygen Consumed	6.15	6.10	0.05

From these tables it would seem that in the oxidation of one molecule of D-fructose under the above stated conditions, the equivalent of three molecules of glycol aldehyde are involved. Hutchman[11] has shown that D-fructose under the same conditions but in the absence of silver oxide yields lactic acid as one of its reaction products.

When the chemical behavior of the reducing sugars in alkaline solutions is studied under carefully controlled conditions, it is found that the yields of reaction products are functions of the concentration of the alkali and the temperature used. Shaffer[29], Friedemann and co-workers have shown that the concentration of the carbohydrate used has a definite influence on the yields of lactic acid obtained from glucose and ketotriose, dihydroxyacetone.

Among the soluble bases used for work of this nature are potassium, sodium and calcium hydroxides, and more recently Torstensen[31] has used tetraethyl ammonium hydroxide, benzyl trimethyl ammonium hydroxide, trimethyl sulfonium hydroxide, and guanidonium hydroxide. The general behavior of these compounds with reference to the yields of lactic acid is much the same, the chief differences being quantitative in character. The generally accepted mechanism for the conversion of D-glucose, D-fructose and D-mannose into lactic acid is given in the following equations.

The Conversion of D-Gluco-, D-Manno, and D-Fructopyranoses into DL Lactic Acid



The lactic acid yields obtained by the action of the three related sugars, D-glucose, D-mannose and D-fructose[12] in potassium hydroxide solutions at 50° are much more alike than at 25°, and at 75°, these curves are practically identical, but the maximum yield is less than at 50°.

The yields of lactic acid may be considered as a quantitative measure of the extent to which the sugar molecule has undergone fragmentation to form glyceric aldehyde. Hass[9] and Cornthwaite[7] have shown that the yields of lactic acid from glyceric aldehyde and dihydroxyacetone are functions of the experimental conditions used.

Plunkett[27] has shown that if aldehydo-D-glucose pentaacetate is used instead of the ordinary D-glucopyranose pentaacetate there is a maximum yield of lactic acid at approximately 2.5 N KOH, while with pyranoid form the highest yield of lactic acid thus far obtained was 50% at 7.0 N KOH. This maximum point in the yields of lactic acid obtained in the case of aldehydo-glucose is attributed to the rearrangement of the hexose sugars to saccharinic acids, because Hoff[8] has experimentally shown that with D-galactose the β-meta-galactosaccharinic acid yields increase with the alkalinity and the temperature. The significance of these statements, as shown above, lies in the fact that they conclusively show that the reducing sugars in alkaline solutions undergo two general reactions simultaneously, viz, one in the direction of *fragmentation*, and one in the direction of *rearrangement*. Not only do they rearrange in soluble bases to saccharinic acids, but in the alkaline degradation of maltose, Benoy[5] found the epimeric sugar of D-glucose, namely, D-mannose. This and other examples show that the Lobry de Bruyn[4] and Alberda van Ekenstein transformation may also occur in these strongly alkaline systems in the regions of low alkalinity in quite the same manner as those investigators found by the use of mild bases such as lime water.

By reason of the relation of lactic acid to glyceric aldehyde and dihydroxyacetone, this acid may be considered their common saccharinic acid, in the same way as Hockett[10] has pointed out that acetic acid is the saccharinic acid of the simplest carbohydrate, glycol aldehyde.

When 4-hexosido-hexoses, such as maltose and cellobiose, are subjected to the same experimental conditions as used above with the hexoses, Benoy[5] and Torstensen[31] have found the yields of lactic acid to be one-half of those obtained from an equivalent solution of D-glucose. This is not only true when potassium hydroxide is used as the base but it is also true when benzyltrimethyl ammonium hydroxide is employed. These reactions are understood from the following equations:

(D—Keto-Fructose)

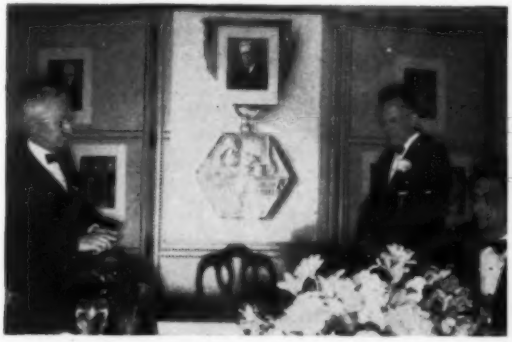
(D—Fructo-pyranose)

(α β-D-maltose)
(Aldehydo-D -maltose)
(2-Glucosido-D Erythrose)
Glycol Aldehyde)
(2-Glucosido-D-Erythrose)
(2-Glucosido-D-Erythrose-2, 3 Enediol)
(Erythrose 2, 3-Enediol)
(α, β-D-Glucose)

From these equations, it can be seen that the 4-hexosido-glucose undergoes fragmentation to yield 2-glucosido-erythrose and glycol aldehyde. In alkaline solutions 2-glucosido-erythrose should form 2-glucosido-2,3 erythrose-enediol which is then hydrolyzed in alkaline solution into D-glucose and D-erythrose. An examination of these equations shows that the reducing section of the maltose molecule was converted to the tetrose, erythrose, and glycol aldehyde, neither of which is known to yield lactic acid in alkaline solution under the conditions used in these experiments. The hydrolytic cleavage of the 2-glucosido-D-erythrose-2,3-enediol in alkaline solution is a chemical reaction in harmony with Schmidt's view because the glucosidic substituent on carbon-2 of D-erythrose 2,3, enediol is twice removed from the *double bond in the enediol*. The glucose at carbon 4 of the reducing section of the maltose molecule is released by alkaline hydrolysis as indicated in the above equations, i.e., only one half of the maltose molecule is thus available for lactic acid formation.

Gehman[16] and Kreider has shown that cellobiosidodihydroxyacetone will only yield the same amount of lactic acid as an equivalent amount of glucosido-dihydroxyacetone, i.e., sections A and C are responsible for lactic acid.

(*continued on next page*)



Dr. William L. Evans, Dr. Harry L. Fisher, and Dr. H. B. Hass, as Dr. Evans accepted the medal

(A)
(B)
(C) + alk
+ alk
H₂O
(Cellobiosido-dihydroxyacetone)
(Cellobiosido-dihydroxyacetone-1, 2-enediol)
Triose-enediol)
(α, β-D-Cellobiose)

In alkaline solution, the A section of the trisaccharide undergoes enolization as indicated, a reaction which is followed by alkaline hydrolysis to yield dihydroxyacetone enediol and cellobiose. The mechanism of this alkaline cleavage of the enediol is the same as that given in the example immediately preceding this one. It is well known that dihydroxyacetone is easily converted to lactic acid in alkaline solutions.[29], [7]. The other product of the reaction, cellobiose, will be reacted upon by the alkali in the same manner as indicated above for maltose, thus leaving the central molecular unit, B, in the trisaccharide as the nonproducer of lactic acid.

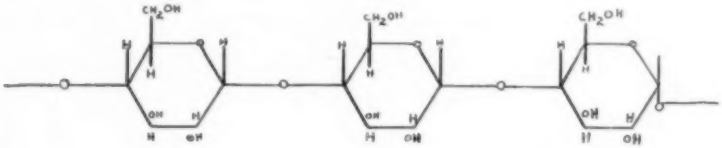
When trisaccharides of the type 6-maltosido-glucose, (i.e., section A is a hexose sugar instead of a triose as above), were studied under the general conditions used in these experiments, it was shown by Nichols[26] and McDowell that the middle hexose, i.e., section B, is a nonproducer of lactic acid. This was shown to be the case by the fact that the lactic acid obtained from two equivalents of glucose, i.e., sections A and C, did not exceed the yields obtained from the trisaccharide itself. The yields obtained from three equivalents of glucose, i.e., sections A, B and C would exceed those obtained from the trisaccharide itself. Furthermore, McDowell[20] found that the amount of lactic acid produced in the interaction of alkalies and 6-lactosido-glucose was practically the same as that obtained from a mixture of equivalent amounts of D-glucose (A section) and D-galatose (C section). This is also in harmony with the views set forth above with reference to the reaction mechanism involved in these chemical changes.

In marked contrast to this inhibited behavior of the alkali toward a hexose molecule bearing an hexose substituent on carbon 4 is the chemical behavior in alkaline solutions of some trisaccharides, such as 6-melibiosido-glucose and 6-gentiobiosido-glucose. These trisaccharides have no inhibitory factor on carbon 4, as in the maltose type and should therefore react to give yields of lactic acid like mixtures containing equivalent amounts of the individual hexoses composing the trisaccharide under investigation. This was found to be true.

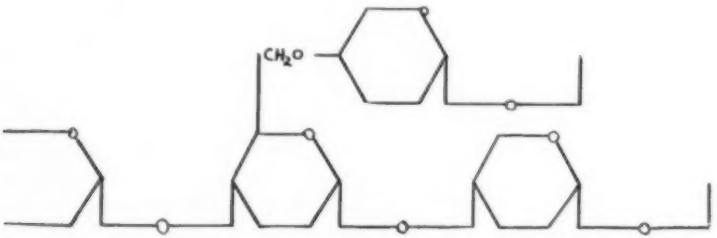
If this general mechanism held true in alkaline solutions of the larger carbohydrate molecules such as cellulose, in which, according to Haworth[17] and Machemer, carbon-atom-4 in each hexose unit, except the one on the non-reducing end, carries a glucose molecule as a substituent, then the so-called end residue, or the last glucose molecule,

would be the only one that could yield lactic acid in the cellulose molecule. Should the alkaline solution of cellulose have access to oxygen then this relationship would probably not hold true.

In a paper just published by Kurt H. Meyer[21] the use of the word *amylose* is limited to that carbohydrate portion of starch which has the maltose-like structure and when expressed after the manner of Haworth it has an *unbranched chain*, i.e.,



For the carbohydrate portion of starch which has the *branched chain* Meyer assigns the name *amylopectin*, thus making the use of these names to rest on structural grounds. The following is used by him to illustrate the point in an unbranched chain where branching could occur.



On the Haworth nomenclature, cellulose would be considered by Meyer as an *unbranched* chain. Meyer[21] states that "the socalled amylose consists essentially of a polymeric homologous mixture of unbranched chains in which 100 to 700 glucose residues are united in α-1 :4 glucosidic arrangement" while "amylopectin consists of giant, branched molecules of 500 to more than 2000 glucose residues in which branching occurs on the average at every 25th. glucose unit." From the above statements concerning the probable behavior of cellulose towards alkalies in a non-oxygen atmosphere, it would be safe to conclude that the amylose component of starch would show the same behavior under the same experimental conditions. An investigation of the behavior of

these larger carbohydrate molecules as well as the end-groups of residual dextrins in alkaline solutions would be a profitable inquiry from many points of view. The data thus obtained would add greatly to the chemical theory of the carbohydrates.

Finally, the purpose of this discussion has been to present a view of a research field in which but relatively few investigators have chosen to work. That the members of the carbohydrate family are of outstanding importance is known to all. Not only are they important as basic materials in certain industries, but the central unit of all carbohydrates, namely, glucose, is the most important compound known to man.

It is much to be hoped that with our increasing number of physical chemical research tools, our ever expanding chemical theory, and our increasing knowledge of the chemical behavior of the larger organic molecules, that our explorations into the carbohydrate area of chemistry, will bring forth facts and generalizations that will contribute in some measure to the happiness and peace of mankind.

Again, I wish to thank THE AMERICAN INSTITUTE OF CHEMISTS for having made this occasion possible.

REFERENCES

1. Baeyer, Adolph von, Ber., **3,** 67 (1870).
2. Busch, K. G. A., Clark, J. W. , Genung, L. B., Schroeder, E. F., and W. L. Evans, Jour. Org. Chem., **1,** 1 (1936).
3. Charlton, William, Haworth, W. N. and Peat, S., Jour. Chem. Soc., 89, (1926).
4. de Bruyn, L. and van Ekenstein, A., Rec. trav. chim., **14,** 203 (1895); **15,** 92 (1896); **16,** 257, 262, 282 (1897); **18,** 147 (1899); 19, 1 (1900).
5. Evans, W. L., and Benoy, Marjorie P., J. A. C. S., **52,** 294, (1930).
6. Evans, W. L., and Conaway, R. F., J. A. C. S., **52,** 3680, (1930).
7. Evans, W. L., and Cornthwaite, W. R., J. A. C. S., **50,** 486 (1928).
8. Evans, W. L., Edgar, Rachel H., and Hoff, G. P., J. A. C. S., **48,** 2655 (1926).
9. Evans, W. L., and Hass, H. B., J. A. C. S., **28,** 4703 (1926).
10. Evans, W. L., and Hockett, R. C., J. A. C. S., **53,** 4384 (1931).
11. Evans, W. L. and Hutchman, J. E., J. A. C. S., **50,** 1496, (1928).
12. Evans, W. L. and O'Donnell, D. C., J. A. C. S., **50,** 2543, (1928).
13. Fischer, Emil, Ber., **24,** 1836, 2683 (1891).
14. Fischer, Emil, Ber., **28,** 1145 (1895).

15. Fittig, Rudolph, Zeits. fur Chemie, 12, 266 (footnote), 1869; Cf., Ueber die Constitution der Sogenannten Kohlenhydrate, Universitat Tübingen, 1871.
16. Gehman, H., Kreider, L. C., and Evans, W. L., J. A. C. S., **58,** 2388 (1936).
17. Haworth, W. N., and Machemer, Jour. Chem. Soc., 2270 (1932).
18. Hlasiwetz, H. and Habermann, J., Ann., **155,** 120, 1870.
19. Levene, P. A. and Meyer, G. M., J. Biol. Chem., **69,** 175 (1926).
20. McDowell, H. D., To be published.
21. Meyer, Kurt H., Advances in Colloid Science, **1,** 143 (1942); Interscience Publishers, Inc., New York.
22. Nef, John Ulric, Proceedings of the American Academy of Arts and Sciences, **27,** 102 (1891-1892); **30,** 151, (1894-1895); Ann., **270,** 267 (1892); **280,** 291 (1894); **287,** 265, (1895); **298,** 202 (1897); **309,** 125 (1899); **318,** 1 (1901); **335,** 191 (1904).
23. Nef, John Ulric, Ann., **357,** 214 (1907).
24. Nef, John Ulric, Ann., **376,** 1, (1910).
25. Nef, John Ulric, Ann., **403,** 204 (1914); **376,** 1 (1910); Cf. Evans W. L., Chemical Reviews, **6,** 281 (1929).
26. Nichols, S. H., Jr., Evans, W. L., and McDowell, H. D., J. A. C. S., **62,** 1754 (1940).
27. Plunkett, R. J. and Evans, W. L., J. A. C. S., **60,** 2847 (1938).
28. Schmidt, Otto, Chem. Reviews, **17,** 137 (1935).
29. Shaffer, P. A. and Friedemann, T. E., Jour. Biol. Chem., **86,** 345 (1930).
30. Tollens, Bernhard, Ber., **16,** 921 (1883).
31. Torstensen, Hilda Holmes, to be published.
32. Cf., Waters and Lowry, "Physical Aspects of Organic Chemistry , 142 (1936), D. Van Nostrand Company; "Theories of Organic Chemistry", Ferd. Henrich, translation by Treat B. Johnson and Dorothy A. Hahn, 1922, John Wiley and Sons, Cf., Nef. J. A. C. S., **26,** 1549 (1904).
33. Wohl, A. and Neuberg, C., Ber., 3099 footnote 2, (1900).
34. Wolfrom, M. L., J. A. C. S., **51,** 2188 (1929).

Dr. Gustav Egloff, Mr. Walter J. Murphy,
and Dr. W. T. Read

The Chemist in Today's Industry

By Dr. Donald Price, F.A.I.C.

***Technical Director, National Oil Products Company,* Harrison, New Jersey.**

IT IS hardly possible to give any statistics on what is happening to the chemist under present war conditions. In fact it would be a thankless task to collect such figures as they would soon become obsolete in view of the rapid changes taking place. Certain things are clear, however. The war has undoubtedly occasioned an enormous demand for chemists. Private industry, the Civil Service and various war research groups are competing actively for the rapidly dwindling supply of trained chemists.

A representative of a large rubber company told the writer that they had to have two hundred chemists right away and would need an equal number within a few months. He was also told by a professor in a large eastern university that chemical concerns were now contracting for 1943 graduates. The representative of one company wanted eighteen Ph. D.'s and hoped to get about the same number at several other universities. Needless to say the institution in question did not have even one Ph. D. available.

The salary situation presents a somewhat confused picture. The greatest demand seems to be for chemists with the least training, the college graduates with a major in chemistry. And in this category salaries seem to have advanced at least ten per cent over a year ago, although one occasionally hears rumors of such recent graduates being offered two hundred per cent of the usual minimum salary for chemists with this type of training. Such rumors are hard to confirm. There is also a large demand for analytical chemists, graduates with several years of experience or men who have taken the Master's degree. The salaries here have also advanced in about the same proportion. There appears to be the least demand for the most highly trained Ph. D. research men, but the salaries paid by the large companies who select such men carefully are apparently about ten per cent higher than a year ago.

Despite the active demand for chemists, the situation presents some strange anomalies. The "situations wanted" columns of our technical magazines still list a number of applicants. The writer, in common with others in a comparable position, receives employment applications from chemists almost every day. Furthermore, full use does not seem to be made of the services of highly skilled older men. A friend of the writer's, a very active man in his early fifties, who is not only an extremely able chemist, but has a reputation in several other scientific fields, recently experienced considerable difficulty in getting a position and was refused by one of the defense research groups solely on the grounds of age.

The general situation seems to point to the need for some central agency on a national scale which will effectively bring employers and chemists together and utilize to the full the skilled older men.

Naturally, the war has had a profound effect upon research in the chemical industry. Within a year's time we have gone from an economy of plenty where the problem was to find uses for surplus chemicals to a situation in which almost all chemicals are scarce. Since we entered the war, research laboratories have been obliged to turn largely to research directly concerned with the war, and many basic projects have had to be abandoned or seriously curtailed.

However, almost every concern maintaining a sizable research laboratory is continuing at least a few of its long range research projects, if possible. This policy is likely to contribute much to the war effort as well as to provide products and processes which will carry the industry after the war.

Obviously, winning the war comes first, for if we should lose it nothing else would matter much. However, the important bearing of long range research projects on the war effort might easily be overlooked. We never know quite what will come out of research. The chemical industry differs fundamentally from most other industries in that it depends for its very existence upon the advancement of a basic physical science, chemistry. If chemical research should stop it would not be long before we would have no chemical industry as we know it. It would, therefore, be highly unwise to abandon all basic long range research even under the stress of war. There is reason to believe that it has not been abandoned either in England or Germany.

Manifestly, the present is no time to initiate new long range projects, but where such programs are well advanced as many as possible should

be kept going. This makes the research director's job more difficult than ever, as he has to decide what is to be dropped and what is to be retained. Considerable ingenuity is required to decide what long range projects are likely to be most fruitful in results valuable for the war effort as well as for after the war.

Another chemical activity of paramount importance is the study of applications for products already developed in our laboratories and pilot plants. We have available a vast number of such products which have been produced by research and which may not have even gone into the production stage, and on the other hand we have the government and the war industries crying out for all kinds of new materials. Under the circumstances the study of applications for these new products becomes vital to the war effort. Normally this process would take a slow course, but it should now be tremendously speeded up.

The Technical Point of View

By Dr. Arthur B. Ray

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WHEN your Committee asked me to take part in the Symposium on "The Chemical Industry At War" by discussing "The Technical Point of View", I hesitated to accept the invitation because of my limited information regarding details of the many chemical processes contributing to the war effort. A talk with Prof. Turner, however, led to the conclusion that an enumeration and brief discussion of the main technical developments bearing upon the war effort was what the Committee had in mind. I will, therefore, very briefly present some information from published records which will give a high-lighted picture of the technical status of chemical industry as of the beginning of this war and, for comparison, at the beginning of World War No. 1. I must add that I greatly appreciate the invitation to take part in this Symposium.

In considering the chemical industry in the United States from the standpoint of its ability to contribute to the war effort *now* and its ability to contribute at the beginning of World War No. 1, the first reaction is

one of satisfaction at the availability of so many fully developed technical processes which can directly benefit the war program. The situation was quite different at the beginning of World War No. 1. Many of the vital chemical needs in those days required the development of manufacturing processes before plants could be built to produce the much needed materials. Now, we have the processes in operation or ready to operate when manufacturing facilities are available. This does not mean, of course, that there is no need for further improvement of technical processes to keep pace with the tremendous demands of the war effort, but it does mean that there will be no serious delays because of the necessity of developing processes. Enumeration and brief discussion of several important chemical processes and products will, I believe, substantiate the opinion that I have just expressed.

Fixed Nitrogen

Fixed nitrogen in tremendous amounts is one of the essentials for any war effort. At the beginning of World War No. 1, the United States was dependent upon importations of Chilean nitrate and upon by-product ammonia for our fixed nitrogen. Development of nitrogen fixation processes had proceeded in Europe to the point where large German plants were producing fixed nitrogen during the war period, but in 1917 there was no commercial production of fixed nitrogen in the United States. The plants constructed at Muscle Shoals during the war did not get into production until afterward. Since that time technical developments in the fixed nitrogen field and extensive plant construction have made the United States entirely independent of importations of fixed nitrogen. It is estimated that, in addition to by-product nitrogen, our production capacity for fixed nitrogen will shortly exceed 450,000 tons per year. It is clear, therefore, that, from the standpoint of fixed nitrogen supply, the United States is in an excellent position due to the development of efficient nitrogen fixation processes and erection of ample production facilities.

Toluene

Toluene is another essential material for the war effort. During World War No. 1, the only available toluene was that recovered from coal distillation processes either in the manufacture of by-product coke or in the manufacture of gas. Scarcity of toluene available from these sources ran the price up to $2.85 per gallon in 1916. The largest production during World War No. 1 was just under 15,000,000 gallons in

1918. In contrast to the situation at that time, technical processes for the manufacture of toluene from petroleum hydrocarbons are available for immediate translation into plants for the production of practically unlimited quantities of toluene. The toluene productive capacity of plants completed or under construction is expected to be five times the present productive capacity. It is evident that, from the technical point of view, the toluene situation is well in hand.

Organic Chemicals

The field of organic chemicals is so broad that I shall only be able to discuss very briefly a few outstanding products. It is fair to say that in 1917 the United States was largely dependent upon Europe for many essential organic chemical materials, notably dyes and pharmaceuticals. If the World War No. 1 can be said to have resulted in anything worthwhile, we can credit it with the impetus given to the development of an organic chemical industry in the United States. Our synthetic organic chemical industry, as we know it, was non-existent at the beginning of World War No. 1, but it now surpasses that of Germany or of any other country. The process of producing acetone by fermentation was brought to fruition during World War No. 1 but this development, which increased the supply of acetone over that then obtainable from wood distillation, is now far overshadowed by the synthetic processes of producing this solvent and many other solvents and organic chemicals from petroleum and natural gas products. Ether and ethanol necessary for the production of smokeless powder are being made by synthetic processes.

During World War No. 1 there was a decided shortage of dyes because these materials had been largely imported from Germany. The rapid development of the dye industry in the United States is not news but it is a satisfaction to be able to state that we are now independent in this field.

The development of processes for the manufacture of many drugs and pharmaceuticals and the erection of manufacturing facilities also means that the United States is self-sufficient in this field. An outstanding achievement in recent years has, of course, been the discovery and development of the sulpha drugs which are saving lives on every battlefield, as well as in civilian hospitals in the country. The technical developments responsible for making these life saving drugs available will undoubtedly rank as one of the greatest achievements of the last decade.

We have no doubt but that the experience gained with the use of sulpha drugs during the exigencies of war will result in even greater benefit to mankind.

During recent years research has shown the important part which vitamins play in our daily life and activities. Technical processes for the extraction and syntheses of important members of this group of compounds have made it possible to utilize these materials on a large scale. The use of vitamins in the preparation of food stuffs, such as bread, will no doubt raise the health standards of the country. From the technical standpoint, the United States is well able to take advantage of the help which vitamins can offer. Quantities of vitamin B_1 (thiamine hydrochloride), vitamin B_2 (riboflavin), and the P-P factor (niacin) will be available to meet the military and civilian requirements.

While I have spoken specifically of a small number of organic chemicals, as illustrations, it must be remembered that technical achievements enable the synthetic organic chemical industry to produce literally thousands of compounds which are not only vitally needed for the war effort but which are essential for civilian needs. The entire synthetic organic industry is geared to produce the materials which the tremendous war effort requires. The technical processes have been developed over a period of years and it is now only necessary, in most cases, to expand or to build manufacturing equipment to produce the quantities of solvents, plastics and numerous other organic chemicals required.

Special Petroleum Products

It has been said that this war is being fought by and for petroleum. The United States is particularly fortunate in having ample supplies of crude oil as well as processes and facilities for transforming this crude oil into the specified products required for military uses. In particular, I might mention that the base materials and processes required for the production of one-hundred octane gasoline are abundantly available in the United States and that the goal set for the production of high quality aviation fuel is 250,000 barrels per day. The importance of high octane gasoline to the war effort cannot be overestimated. The most important method of producing more power from a given size and weight aircraft engine is by making the engine burn more air and fuel by increasing the manifold pressure with a super-charger. Increased manifold pressure increases explosion pressure and requires a higher octane fuel in order to avoid detonation. The use of super-chargers with high octane fuel increases the speed cruising ranges and ceiling of the plane. The use

of one hundred octane aviation fuel will give our aircraft a definite advantage over aircraft of our enemies and may, in effect, be one of the deciding factors of the war. It is interesting to speculate regarding the effect of the development of high octane fuel upon civilian uses after the war. It may make possible the production of automobiles equal in performance to present day vehicles which will be lighter in weight and more economical to operate.

Other technical advances have been made in the production of petroleum lubricants to meet the special needs of mechanized warfare. Availability of suitable coolants for engines has been an important factor in the development of engines of the liquid cooled type. In general, it may be said that the technical processes which are permitting the production of many specialized petroleum products are definitely aiding the war effort.

Rubber

If the present war is being fought by and for petroleum, it must be considered that it is also being fought on rubber. Certainly, rubber is a vital and essential material without which modern, mechanized war could not be conducted. I do not need to go into details regarding the rubber situation because everyone is more or less familiar with it from the daily newspaper publicity.

The situation is well in hand from the technical standpoint. The United States is fortunate in having several processes ready for the production of synthetic rubber from the unlimited petroleum and chemical raw materials which can be made available. Processes are also available for the efficient reclaiming of old used rubber. Translation of these processes into plants with the necessary productive capacity will require almost superhuman effort but we are all confident that our military machine will not suffer for lack of rubber, part of which will be made synthetically from our domestic products. The petroleum, chemical, and rubber industries are coöperating in the all-important job of quickly getting an adequate supply of rubber for our war and essential civilian needs. The fact that the synthetic rubbers are superior to natural rubber for some applications probably means that the synthetic rubber industry is here to stay and that the United States will not again be dependent upon a foreign source of supply.

Metals and Alloys

The demand for metals such as aluminum, calcium, and magnesium, was by no means as great in World War No. 1 as it is at the present time. From the technical standpoint, processes are available for the commercial production of these metals in large quantities and plants are under construction which will deliver the amounts required for the war effort. Production of aluminum in 1918 was somewhat less than 150,000,000 pounds. According to announced plans, expansion of production facilities will enable aluminum to be produced at the rate of 2.1 billion pounds per year. The production of magnesium in 1918 was less than 300,000 pounds. The authorized productive facilities will enable magnesium to be produced at the rate of approximately one billion pounds per year. Calcium was not produced in commercial quantities in 1918, whereas it is now being produced in quantities required by industry in the war effort for treating steels and other uses. The development of processes for the production of magnesium and bromine from sea water has been spectacular.

Alloying elements used in the manufacture of special steels are in tremendous demand today and technical processes for the treatment of low grade ores to produce the requirements of metals such as tungsten, molybdenum, vanadium and others, assure a supply of these vitally important alloying elements. Processes for producing tin from low grade ores and recovering tin from scrap will probably prevent any shortage of tin from seriously hampering the war effort. Recently developed processes for producing smooth castings from high melting alloys are aiding in the war effort by permitting the rapid production of small parts made from these high melting and extremely hard alloys.

Chemical Warfare Products

When chemical warfare was introduced in World War No. 1, it was necessary for the United States to develop processes for the production of both offensive and defensive materials required. The tremendous development of the synthetic organic chemical industry during the last decade has made the United States the most powerful potential chemical arsenal in the war. Technical processes for the manufacture of toxic materials are developed and it is only necessary to erect manufacturing

plants or modify existing chemical plants to produce practically unlimited amounts of toxic materials which might be used in warfare. The basic materials for manufacturing the toxic gases are available in unlimited quantities, thanks to the expanded synthetic organic chemical industry.

Activated carbon of the vapor adsorbent type was developed during World War No. 1 primarily for use in gas masks to protect against the toxic warfare agents. It was necessary to develop processes for the production of this material as well as to erect the plants for the production of the urgently needed adsorbent. The total amount of gas mask carbon produced in the United States during World War No. 1 amounted to approximately 6,000,000 pounds. The preferred raw material was coconut shells which, of course, had to be imported—principally from the Philippines. During the last decade, processes have been developed for the production of extremely high quality gas mask carbon from domestic materials available in unlimited quantities. Manufacturing facilities utilizing these processes will produce all of the activated carbon required for military or civilian protection against toxic gases. In addition to this use of activated carbon, this material developed as a war need has found many industrial applications, one of which is the recovery of solvent vapors normally lost in exhaust air from many processes. Activated carbon is now recovering for reuse tremendous quantities of vitally needed organic solvents which could not be recovered by any other means. In effect, these solvent recovery installations greatly reduce the load upon solvent producers and thus materially aid the war effort.

Plastics

In World War No. 1, plastics did not play a very important part because the "Plastic Age" was just beginning. The technical developments in the last twenty years have made available a tremendous number of different types and grades of plastics with a wide range of properties. This is definitely the "Plastic Age" and plastics are playing an ever increasing rôle in supplying military and civilian needs. Plastics are being substituted for metals and in some cases doing a better job. They are being used to make a myriad of gadgets and devices which are essential to mechanized warfare. They are being used for the insulation of electric wires, for the production of shatter-proof glass and glass substitutes, for producing water-proofing coatings and materials, and for

innumerable other uses which will undoubtedly contribute to the successful outcome of the war. It should also be pointed out that the manufacture of these plastics is made possible by the extensive chemical industry which has been built up since World War No. 1.

The preceding recital of the status of a few important chemical products and processes definitely indicates that, from the technical standpoint, the chemical industry in the United States is playing an important part in the war effort. The problem now is not so much development of technical processes as it is the erection and getting into production of plants to produce the needed chemical and metallurgical materials. There will always undoubtedly be a continuing need for technical developments to keep apace with the changing war effort, but I am confident that the United States will keep in the forefront of these developments.

Announcement

A new Roster of THE AMERICAN INSTITUTE OF CHEMISTS will be published in one of the fall issues of THE CHEMIST. Every member of the INSTITUTE is requested to fill out and return the coupon below so that he may be listed correctly in our new membership list.

Secretary
THE AMERICAN INSTITUTE OF CHEMISTS
233 Broadway
New York, N. Y.

Please list my name as follows in the new directory.

Name .....

Business Position or Title .....

Name of Firm .....

Address of Firm .....

Henry Granger Knight

July 21, 1878 — July 13, 1942

Past President of THE AMERICAN INSTITUTE OF CHEMISTS

Medalist, 1941

In the untimely death of Dr. Henry G. Knight, the world of science has lost one of its leading spirits; the Government, one of its ablest administrators, and THE AMERICAN INSTITUTE OF CHEMISTS, one of its best friends. From the time he joined the INSTITUTE, in 1927, Dr. Knight gave generously of his time and interest to INSTITUTE affairs, serving as a member of important committees on the National Council, and as President for one term.

THE CHEMIST, dedicated to the interest of chemists as human beings, does not need to record the passing of this valued member with just a paragraph of factual data on his life, activities, and accomplishments. They make a notable cumulative account, augmented regularly as some new honor came to this distinguished chemist, and they have been published in many places and on many occasions—the latest for us in the issues for March and May, 1941, when Dr. Knight was awarded the medal of the INSTITUTE.

When and if those memoirs on which he worked faithfully from time to time are published, the full details of Dr. Knight's uniquely American story may become known: how a ten-year-old boy, inspired by a promise to his dying mother, feels as he starts out to "be somebody"; the struggle for a formal education, complete with Ph.D., most of it by the hardest way; the progress of a teacher from a one-room rural school to the deanship of important agricultural colleges; and finally, the growth of the Chief of a new Bureau in the U. S. Department of Agriculture into the director of the world's largest research organization.

Any mere recital of vital statistics, however voluminous, is usually lifeless at best because it so rarely conveys any idea of the personality

thus catalogued. For all his learning and his scientific attainments, Henry Knight was an exceptionally well-rounded person and an intensely human being. One never could guess what new object of his perennially boyish enthusiasm would turn up on his desk, or out of his pockets. He loved the outdoors with all it could give him of hunting, fishing, motoring, and golf, and he was an excellent amateur photographer. Fond of music and dancing, a delightful *raconteur* with a quiet, keen, kindly sense of humor, he was a welcome addition to any gathering of friends or professional associates. And there are few among us that can claim so many of both, in all walks of life and in all forty-eight States of this country. An unostentatiously efficient executive, he had a rare gift for organization and administration; friendly yet dignified, he soon won the coöperation and personal devotion of all that worked with him in any capacity.

No author of such a "success story"—so typically Horatio-Alger-esque—would ever have been cruel enough to cut his hero off at not-quite-64. They all presumably lived on and on, basking in the golden sunset of a well-spent life. That is because those good old-fashioned heroes did not live in this mad, war-torn period of the twentieth century.

The demands upon Dr. Knight's time and energy were very heavy during the past few years, and the task of putting his entire Bureau of Agricultural Chemistry and Engineering on war work acutely increased his sense of responsibility. Excerpts from some of his last letters show how sorely he was troubled:

"Frankly, I don't know when I'll be in New York again. It is becoming increasingly difficult for me to get out of the city. My calendar is usually so full that there are days with no opportunity to dictate letters, and the pressure is becoming greater all the time. But that's war for us!

"I'm still hoping for a vacation sometime, but probably won't get it now or until the war is over. Of course I haven't had one for years, so I suppose it shouldn't matter, except that I am rather fagged out—in fact more than usual. The only thing I can do is to save myself as much as possible by getting plenty of rest and refusing evening engagements. I presume I'm a fool, but when I've tried to take a couple of days off I've been called back. Things are moving so rapidly that a lapse of a week changes the picture materially.

Anyway, I hope to stay with the job until this mess is over and then I think I'll let someone else squirm during the reconstruction period. I don't think I shall enjoy trying to gather up the pieces following this war."

Henry Granger Knight should be accounted a casualty of World

War II on equal standing with any hero in the armed forces. When the world is peaceful once more and the contribution of this simple but truly great man and brilliant chemist can be viewed in its proper perspective, it will undoubtedly be agreed that no one in recent times, perhaps no one since Liebig, has been responsible, directly or indirectly, for so many accomplishments in the practical applications of chemistry to agriculture, and in the linking of agriculture to industry. As long as they endure, the four great regional laboratories to which Dr. Knight gave so much intelligent thought and paternal devotion will stand at the four points of the compass as monuments to him. Every farmer in the land has and will have many reasons to bless his name. So have all of us, and so should many future generations who will unwittingly enjoy the fruits of his labors.

FLORENCE E. WALL, F.A.I.C.

Resolution

WHEREAS, We, the National Council of THE AMERICAN INSTITUTE OF CHEMISTS, INC., have learned with deepest sorrow of the death of our associate and friend, Dr. Henry Granger Knight, and

WHEREAS, Dr. Knight as a teacher has imbued many young men with an enthusiasm for chemistry and an appreciation of its importance to humanity, and

WHEREAS, as Chief of the Bureau of Chemistry and Soils, now the Bureau of Agricultural Chemistry and Engineering of the United States Department of Agriculture, he has been of inestimable value to the agricultural industry of the United States and through it to every American citizen, and

WHEREAS, as President of THE AMERICAN INSTITUTE OF CHEMISTS, he gave evidence of his interest in the individual chemist as a medium for the advancement of successful civilization, and

WHEREAS, in recognition of his noteworthy and outstanding service to the science of chemistry and the profession of the chemist in America, THE AMERICAN INSTITUTE OF CHEMISTS, INC., did bestow upon him its annual medal, and

WHEREAS, his high sense of honor, his upright character and his clear judgment will ever be an inspiration to us, and

WHEREAS, his lovable nature, his cheerfulness, and his kind and thoughtful qualities will ever be remembrances of his friendliness,

THEREFORE, BE IT RESOLVED, that the Council of THE AMERICAN INSTITUTE OF CHEMISTS, INC., hereby records its lasting appreciation and deep sense of loss of one who has been a true friend of chemists; and that our sympathy be extended to his family; and that a copy of these resolutions be spread upon the minutes of the National Council of THE AMERICAN INSTITUTE OF CHEMISTS, INC.

Chicago Chapter of the Institute

THE AMERICAN INSTITUTE OF CHEMISTS welcomes the newly formed Chicago Chapter of the INSTITUTE.

An open meeting of INSTITUTE members in Chicago, and guests, was held May twenty-seventh, at Huylers' Restaurant, Chicago, with an attendance of one hundred and seventy-five. Following the dinner, the meeting was addressed by Dr. John A. Dienner on "Inventors, Patents and Legislators." This talk was concerned mainly with the effect of recent court decisions, publicity attacks, and proposed legislation in the United States Patent system. The discussion which followed Dr. Dienner's talk brought out enough dissenting opinions to make the discussion interesting. INSTITUTE members considered forming a chapter of the INSTITUTE and a meeting specifically for this purpose was scheduled for June nineteenth.

At the June nineteenth meeting, Dr. V. Voorhees was elected chairman of the Chapter; Mr. H. I. Jones was elected vice-chairman, and Dr. C. L. Thomas was elected secretary-treasurer.

The Chicago Chapter has drawn up an interesting program concerned with subjects of vital importance to the professional status of chemists. At the present time this Chapter will include those chemists in the state of Illinois and the neighboring states of Indiana, Iowa, and Wisconsin.

COUNCIL

OFFICERS

President, Gustav Egloff
Vice-president, Donald Price
Secretary, Howard S. Neiman
Treasurer, Walter J. Murphy

COUNCILORS

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Donald H. Andrews
Frank G. Breyer
Ernest R. Bridgwater
Stuart R. Brinkley
Charles N. Frey
Frank O. Lundstrom
Robert J. Moore
Foster D. Snell
Maximilian Toch

CHAPTER REPRESENTATIVES

New York	*Niagara*	*Philadelphia*	*Washington*
Marston L. Hamlin	A. W. Burwell	Gilbert E. Seil	Albin H. Warth

May Meeting

The 190th meeting of the National Council of The American Institute of Chemists was held on Saturday, May 16, 1942, at the Claridge Hotel, Atlantic City, New Jersey, at 12:30 p. m.

Dr. Harry L. Fisher presided.

The following officers and councilors were present: Messrs: E. R. Allen, Gustav Egloff, Harry L. Fisher, Marston L. Hamlin, Frank O. Lundstrom, J. M. McIlvain, Robert J. Moore, Walter J. Murphy, Howard S. Neiman, Donald Price, W. T. Read, G. E. Seil, W. D. Turner. Dr. R. C. Huston and Miss V. F. Kimball were present.

The minutes of the previous meeting were read and approved.

The following new members were elected:

FELLOWS:

Bailey, Paul F.
Assistant Professor, Loyola University, New Orleans, Louisiana.

Bond, Ralston L.
Research Chemist, National Oil Products Corporation, Harrison, N. J.

Heim, Oscar K. W.
Research Chemist, United Merchants and Manufacturers' Management Corp., New York, N. Y.

Van Heukeroth, Arthur W.
Captain Camouflage Section, U. S. Army, Fort Belvoir, Virginia.

William Wettach
Managing Director, Industrial Paint Company, Haysville, Pa.

ASSOCIATE:

Mabardie, Alexander A.
Vitamin Chemist, Vick Chemical Company, New York, N. Y.

The application of Joseph R. Cataldo to be raised from Associate to Fellow was approved.

There being no further business, adjournment was taken.

June Meeting

The 191st meeting of the National Council of THE AMERICAN INSTITUTE OF CHEMISTS was held on Wednesday, June 10, 1942, at The Chemists' Club, 52 East 41st Street, New York, N. Y., at 6:30 p. m.

Dr. Gustav Egloff presided. The following officers and councilors were present:

Messrs: E. R. Allen, S. R. Brinkley, F. G. Breyer, G. Egloff, H. L. Fisher, M. L. Hamlin, H. G. Knight, R. J. Moore, W. J. Murphy, and H. S. Neiman. Dr. E. H. Northey and Miss V. F. Kimball were present.

The minutes of the previous meeting were approved.

President Egloff announced that a Chapter of the INSTITUTE was being organized in the Chicago district, and this will soon be an active Chapter following its organization meeting to be held during the latter part of June.

President Egloff also stated that a meeting of chemists in the Chicago area was held on Wednesday, May 27th, to discuss the three recent bills introduced into Congress which, if put into effect, would abolish our present patent system. At the Chicago meeting, this subject was discussed by John A. Diemer, well-known patent lawyer.

The subject of membership was discussed, and the Council set as its goal for this year a membership of three thousand, all of whom shall be qualified under the Constitution and By-laws of the INSTITUTE.

The Treasurer's report, showing cash on hand and in banks and savings bonds of $5182.25, was read and accepted.

The Secretary reported that we now have a total of 1698 members.

The Chapter Representative of the New York Chapter reported that the following resolution had been passed by the New York Chapter at its meeting on June eighth:

"RESOLVED: That the Chapter Representative to the National Council be instructed to bring up at the next meeting of the National Council the matter of licensure of chemists in the States of New York and New Jersey and that the National Council be urged to take the necessary initial steps preparatory to the introduction of the INSTITUTE's licensure bill at the next session of the Legislatures of New York and New Jersey."

Upon motion made and seconded, this resolution was accepted and turned over to the Committee on Licensure of the INSTITUTE.

Upon motion made and seconded, the following new members were elected:

FELLOWS:

Balassa, Joseph J.
(1942) *Chemist*, Federal Yeast Corporation, Highlandtown Post Office, Baltimore, Maryland.

Boynton, Emory P.
(1942), *Patent Attorney*, Carbide and Carbon Chemicals Corporation, 30 East 42nd Street, New York, N. Y.

Burry, H. Maxwell
(1942), *Owner and Director*, Long Island Analytical Laboratory, P. O. Box 168, Mineola, L. I., New York.

Ducca, Frederick W.
(1942), *Chemist*, The Bakelite Corporation, Bloomfield, N. J.

Ericks, Walter P.
(1942), *Chemist*, American Cyanamid Company, Stamford, Conn.

Fulton, Ralph G.
(1942), *Development Chemist,* The Bakelite Corporation, Los Angeles, California.

Hanson, Norman D.
(1942), *Chemist,* The Bakelite Corporation, Bloomfield, N. J.

Henry, Guido R.
(1942), *Chemist,* E. I. duPont de Nemours and Company, 3500 Grays Ferry Road, Philadelphia, Pa.

Herbst, Robert M.
(1942), *Associate Professor Organic Chemistry,* New York University, University Heights, New York, N.Y.

Lefferdink, Theodore B.
(1942), *Research Chemist,* The Bakelite Corporation, Bloomfield, N. J.

Mackinney, Herbert W.
(1942), *Research Chemist,* The Bakelite Corporation, Bloomfield, N. J.

Marshall, Walter R.
(1942), *Department Head,* The Bakelite Corporation, Bloomfield, N. J.

Rice, Oscar K.
(1942), *Associate Professor of Chemistry,* University of North Carolina, Chapel Hill, No. Carolina.

Richardson, Stanley H.
(1942), *Chemist,* The Bakelite Corporation, Bloomfield, N. J.

Schaad, Raymond E.
(1942), *Research Chemist,* Universal Oil Products Company, Chicago, Ill.

Stobaeus, Frank H.
(1942), 515 Grove Terrace, South Orange, N. J.

Thompson, Frederick B., Jr.
(1942) *1st Lieutenant,* Sanitary Corps, U. S. Army, Fourth Corps Area Laboratory, Ft. McPherson, Georgia.

Tolpin, Jacob G.
(1942), *Chemist in charge of Survey of Foreign Patent Literature,* Universal Oil Products Company, Chicago, Illinois.

Van Arsdell, Prudence M.
(1942), *Research Chemist,* Universal Oil Products Company, Chicago, Illinois.

ASSOCIATES:

Boehm, Adolph A.
(A.1942), *Chemist,* The Bakelite Corporation, River Road, Bound Brook, New Jersey.

Bourland, James F.
(A.1942), *Research Chemist,* Calco Chemical Division of American Cyanamid Co., Bound Brook, N. J.

Brouillard, Robert E.
(A.1942), *Research Chemist,* Calco Chemical Division of American Cyanamid Co., Bound Brook, N. J.

Cerda, Arthur L.
(A.1942), *Chemical Engineer,* Durez Plastics and Chemicals, Inc., North Tonawanda, New York.

Dhein, Leonard H.
(A.1942), *Research Chemist,* Calco Chemical Division of American Cyanamid Co., Bound Brook, N. J.

Ebel, Robert H.
(A.1942), *Research Chemist,* Calco Chemical Division of American Cyanamid Co., Bound Brook, N. J.

Garty, Kenneth T.
(A.1942), *Research Chemist,* The Bakelite Corporation, Bloomfield, New Jersey.

Granis, Michael
(A.1942), *Research Chemist,* Calco Chemical Division of American Cyanamid Co., Bound Brook, N. J.

Kertesz, Dennis J.
(A.1942), *Research Chemist,* Calco Chemical Division of American Cyanamid Co., Bound Brook, N. J.

Meunier, Alfred C.
(A.1942), *Research Chemist,* Calco Chemical Division of American Cyanamid Co., Bound Brook, N. J.

Nield, Cyril H.
(A.1942), *Research Chemist,* Calco Chemical Division of American Cyanamid Co., Bound Brook, N. J.

Pitt, Charles F., III
(A.1942), *Chemist,* The Bakelite Corporation, Bloomfield, N. J.

Walters, Linwood A.
(A.1942), *Chemist,* The Bakelite Corporation, Bloomfield, N. J.

White, Abner
(A.1942), *Captain Chemical Warfare Service Administrative Officer,* Johnson and Johnson, Gas Mask Division, Chicago Chemical Warfare Procurement District, 4951 W. 66th Street, Chicago, Illinois.

JUNIORS:

Alexander, Mary L.
(J.1942), *Librarian,* Universal Oil Products Company, Chicago, Illinois.

Anderson, Eleanor G.
(J.1942), *Library Research,* Universal Oil Products Company, Chicago, Ill.

Covet, Sylvia
(J.1942), *In Patent Department,* Universal Oil Products Company, Chicago, Illinois.

The Secretary read a letter from Dr. William Lloyd Evans, in which Dr. Evans expressed his interest and pleasure in the Annual Meeting, at which he received the Medal Award of the INSTITUTE.

The Council requested the Secretary to ask each member of the INSTITUTE to secure at least one new member this year.

The Secretary was instructed to send to Dr. Price, Chairman of the Membership Committee, the information and suggestions for a new leaflet to be used to secure membership.

Dr. Henry G. Knight reported that the four Regional Research Laboratories of the Department of Agriculture are now going concerns and contributing actively to the program for national defense.

After discussion of the recent bills regarding patents, the Secretary was appointed temporary chairman of the Patent Committee and the Secretary was requested to prepare a leaflet, to be sent to the members, containing the text of the bills on patents for the general information of our members.

(Note: Since this suggestion, the Committee on Patents of the U. S. Senate, having charge of these bills, has adjourned for two weeks, and at the end of that time, it will abandon the present bills and introduce a new bill somewhat more along the lines of those suggested by the various committees which appeared before it. It was, therefore, felt unnecessary to reprint the old bills, but to await the introduction of the new bill and send it to the membership, if it requires comment.)

There being no further business, adjournment was taken.

Applications for Membership

For Fellows.

Block, Herman S.
Research Chemist, Universal Oil Products Company, Chicago, Ill.

Cahn, Frank J.
Research Chemist, Emulsol Corporation, 59 E. Madison, Chicago, Ill.

Carrick, Leo L.
Professor of Industrial Chemistry and Dean of the School of Chemical Technology, North Dakota Agricultural College, Fargo, North Dakota.

Chenicek, Joseph A.
Research Chemist, Universal Oil Products Company, Chicago, Ill.

Cook, Charles H.
Vice-president, Chief Chemist, The Sterling Varnish Company, Haysville, Pa.

Danforth, Joseph D.
Research Chemist, Universal Oil Products Company, Riverside, Ill.

Davis, Richard F.
Chemist, Patent Department, Universal Oil Products Company, Chicago, Illinois.

Martin, de Simo
Director of Research and Development, Great Lakes Carbon Corporation, 333 North Michigan Avenue, Chicago, Illinois.

Dryer, Charles G.
Research Chemist, Universal Oil Products Company, Riverside, Ill.

Dull, Malcolm F.
Chairman, Department of Chemistry, De Paul University, 2322 Kenmore Avenue, Chicago, Illinois.

Eisenschiml, Otto
Manager and President, Scientific Oil Compounding Company, 1637 S. Kilbourn Avenue, Chicago, Ill.

Friedman, Bernard S.
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ter Horst, W. P.
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Todd, James D.
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Venger, Mildred
Librarian, Universal Oil Products Company, Riverside, Illinois.

For Associate.

Pinkston, John T., Jr.
Research Chemist, Universal Oil Products Company, Riverside, Ill.

Smith, Whitfield W.
Chemist, Baker and Company, Newark, New Jersey.

For Junior.

Giacona, Nicholas V.
Control Chemist, Hammond Paint and Chemical Company, Beacon, New York.

To be raised from Associate to Fellow.

Beichert, Walter J.
Chemist, Lindsay Laboratories, 302 Ashland Place, Brooklyn, N. Y.

Dorn, Herman W.
Research Chemist, Amino Products Company, Rossford, Ohio.

To be raised from Junior to Fellow.

Weitzel, Charles W.
First Lieutenant, C. W. S. *Plant Representative,* New York Chemical Warfare Procurement District, New York, New York.

For Reinstatement to Fellow

Grebe, John J.
Director Physical Research, The Dow Chemical Company, Midland, Mich.

Rudd, Wortley F.
Dean, Medical College of Virginia, Richmond, Virginia.

CHAPTERS

New York

Chairman, Elmore H. Northey *Vice-chairman,* Paul J. Witte

Secretary-treasurer, A. Lloyd Taylor

Oakite Products Company, 22 Thames Street

New York, N. Y.

Council Representative, Marston L. Hamlin

The New York Chapter held its final meeting of the year at The Chemists' Club, May 22, 1942, with an attendance of more than 120 people. Dr. Donald Price called the business meeting to order at eight o'clock. Dr. A. Lloyd Taylor was appointed secretary pro tem in the absence of Dr. Milton Burton, secretary, who has been called to Chicago on war work. Following reports on the committees, Dr. Price turned the chair over to the newly elected chairman, Dr. E. H. Northey, who presided for the remainder of the program.

Dr. George F. A. Stutz of the New Jersey Zinc Company assisted by

Messrs. A. C. Elm and C. E. Barnett of that company gave a talk and demonstration on "Luminescent Materials of the Fluorescent and Phosphorescent Types". Various kinds of fluorescent and phosphorescent paints and dyes were demonstrated in a spectacular manner particularly with reference to their possible application in the defense program. Phosphorescent paints and dyes are activated by "black light" a near ultra-violet light of wave lengths of approximately 3200-4200 Angstrom units, and when so activated, they glow brightly for as long as eight to ten hours. The demonstrations were continued in a completely darkened room with only the near ultra-violet light, which gave a dull purple glow. Dr. Elms wore a "blackout suit" which had a pith helmet and broad bands of material coated with the phosphorescent dye. When this phosphorescent dyed material was activated by the ultra-violet light it glowed brightly and lighted up the whole room. For demonstration, a large piece of cloth dyed with the phosphorescent dye was activated by placing it before the ultra-violet lamp. The cloth was then carried up and down the aisle with spectacular effect.

Four of the ladies were invited to go to the front of the room and one was asked to fold a dollar bill which had been treated with the phosphorescent compound. The ladies were then asked to raise their hands and the audience was told to determine which lady had handled the bill. The fingers of the hand which had touched the bill glowed brilliantly when activated. The application of this procedure as a means of crime detection was thus demonstrated. The teeth of persons standing in the rays of the "black light" fluoresced brilliantly (with the exception of artificial teeth!) Many other demonstrations of the dramatic possibilities of luminescent materials were shown.

Following Dr. Stutz' talk, a quartet consisting of Messrs. R. D. Bonney, K. J. Howe, R. J. Moore, and J. McE. Sanderson appeared dressed in clothing painted with fluorescent paints and with their faces and hands also painted. They rendered a number of selections composed by themselves about the various officers of the INSTITUTE. Unfortunately the laughter of the audience caused the singers to break down at various times and these priceless verses were thus unable to be recorded.

The entertaining program ended at about 9:45 P. M. with a vote of thanks to the program committee, and particularly to Drs. Mattiello and R. J. Moore, for its work in arranging this entertainment.

Niagara

Chairman, L. M. Lawton

Vice-Chairman, George W. Fiero

Secretary, Margaret C. Swisher

Department of Chemistry

University of Buffalo

Buffalo, New York

Council Representative, Arthur W. Burwell

Carl H. Rasch, *Alternate*

Pennsylvania

Chairman, J. M. McIlvain *Vice-chairman,* Maurice L. Moore

Secretary-treasurer, Clinton W. MacMullen

Rohm and Haas Company

Philadelphia, Penna.

Council Representative, Gilbert E. Seil

News Reporter to THE CHEMIST, Kenneth A. Shull

Washington

President, L. F. Rader, Jr.

Vice-president, Donald H. Andrews *Treasurer,* L. R. Heiss

Secretary, Ernest J. Umberger

207 Albany Avenue, Takoma Park, Maryland

News Reporter to THE CHEMIST, T. H. Tremearne

Council Representative, Albin H. Warth

The final Spring meeting of the Washington Chapter for 1942 was held at Wardman Park Hotel on May 29th. Vice-president L. F. Rader presided in the absence of President Deemer, who has been ill for several weeks.

Miss Rolland reported on the medal awards to the various university students.

Frank Lundstrom made a report of the Atlantic City Convention of THE INSTITUTE, and also advised the meeting of the many changes in location of members. It is hoped that members in the Washington Chapter area will keep in touch with Ernest J. Umberger, Chapter secretary, for dates of fall meetings, so that they may continue contact with their fellow members.

The following officers for 1942-1943 were elected: President, L. F. Rader, Jr; Vice-president, Donald H. Andrews; Secretary, Ernest J. Umberger; Treasurer, L. R. Heiss. The Committees for the coming year will shortly be announced.

A partial list of members who are in defense activities shows that J. K. Adams is an auxilliary policeman; C. W. Whitaker is an air warden in his apartment—and he gets cooperation! W. H. Ross has volunteered for decontamination work; L. F. Rader, Jr., and T. H. Tremearne also look for cooperation in their air warden C. D. activities. The Chapter's members are all busy on various defense projects, but these must be held in secrecy. At some future time, it will be of interest to know of the important parts taken by our Institute members during this War.

The Chapter congratulates Dr. Egloff on his election to the presidency of THE INSTITUTE, and wishes him success in his piloting of THE INSTITUTE during the coming years.

BOOKS

RUBBER AND ITS USE. By Harry L. Fisher, F.A.I.C. *Chemical Publishing Company, Inc.* 1941. 5½" x 8½". 128 pp. $2.25.

Dr. Fisher, director of organic research of U. S. Industrial Chemicals, Inc., has, himself, contributed much to the development of the rubber industry in this country during his seventeen years as a research rubber chemist. He tells entertainingly, the story of rubber, as it should be told, from its first use in a Mayan game, "tlachtli", to its status as a world commodity which has become so important that synthetics were created to supplement it. These synthetic rubbers or elastomers and their uses are also discussed.

Chapter headings include, "The History of the Rubber Industry," "Sources and Production of Crude Rubber", "Properties of Crude and Vulcanized Rubber, and the Importance of Vulcanization," "Compounding and Vulcanizing Rubber", "Manufacturing Rubber", "Latex Manufacturing Processes," "Synthetic Rubbers or Elastomers," and "Rubber Derivatives."

Reference works for supplemental reading are given at the end of the book.

This authoritative and interesting story of rubber should be particularly popular at the present time when rubber holds such an important place in the news of the day. Technical information is included for those who desire it, but those unfamiliar with chemistry will find that by skipping the technical formulas, they will still get a fascinating and accurate picture of the rubber industry and its development. This book should be popular with news commentators and writers who prepare releases on rubber and synthetic rubber. It will be equally welcomed by everyone who is interested in obtaining information or statistics on the subject.

Occupational Index Inc., at New York University, New York, N. Y., has issued a six-page leaflet of "Industrial Chemistry as an Occupation", which is one of the series of 67 leaflets describing opportunities in different occupations. Single copies may be obtained for twenty-five cents.

University Microfilms

University Microfilms, 313 N. First Street, Ann Harbor, Michigan, issues microfilms of doctoral dissertations which may never be available in printed form. The current issue of *Microfilm Abstracts* lists descriptions of several manuscripts, such as: "The Preparation and Reactions of the 1, 3-dimethyl-4- and 5-amylbenzenes", (Orville G. Shanholtzer, Ph.D. thesis) University of Missouri; "The Reaction of Phenyl Lithium with Diaryl-and Triarylchloromethanes," (Oliver F. Senn, Ph.D. thesis) University of Michigan; "A Study of Antioxidants with Respect to Vitamin A in Fish Oils," (Orson D. Bird, Ph.D. thesis) Michigan State College. Microfilm prices depend upon the number of pages in the original manuscript. The last paper listed above, for example, is marked, "Microfilm copy of complete manuscript 124 pages at 1¼ cents, total cost $1.55, paper enlargements 6" x 8" at 6c per page.

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F.A.I.C., COLLEGE PROFESSOR OF ORGANIC CHEMISTRY desires change. Ph.D., publications. Teaching position preferred. Details available on request. Please reply to Box 57, THE CHEMIST.

United States Civil Service Examinations

The United States Civil Service Commission has announced that chemists and metallurgists are wanted in various branches of the government and in the Bureau of Mines. Modified requirements permit college teaching to be offered as professional experience. Minimum requirements are bachelor's degree in metallurgy, in chemistry, or in allied subjects. Additional experience is required for higher grades. Salaries range from $2600 for assistant grade, to $5,600 for the principal grade. Women chemists are also considered. Application forms may be obtained at any first- or second-class post office or from the U. S. Civil Service Commission, Washington, D. C.

IMPORTANT

Every member of the* Institute *is reminded to fill out and return the form on page 170.

NEW BOOKS

Rubber and its Use

HARRY L. FISHER

$2.25

An authoritative and practical treatment. Rubber cultivation as well as development of synthetic rubber compounds. Dr. Fisher received the 1940 Modern Pioneer Award and is president of American Institute of Chemists.

Chemical Warfare

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Various types of lethal gases, their development—evaluation and toxicity, as well as treatment, and psychological aspects, etc.

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Latest developments in ultra-violet radiations and uses of ultra-violet light—including chapters on radioactive minerals, etc.

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A general survey of the electrolytic behavior of aluminum alloys at the anode.

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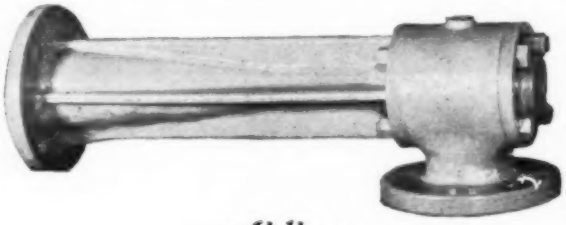

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